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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/788,339

Filing Date: February 21, 2001

Appellant(s): TSUGE, SADAJI

Vincent M. DeLuca
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 15 July 2008 appealing from the Office action mailed 15 January 2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,300,556	Yamagishi et al	10-2001
4,131,486	Brandhorst, Jr.	12-1978
4,667,060	Spitzer	05-1987

4,649,088	Mitsui et al	03-1987
6,307,144	Mimura et al	10-2001
JP 11-307791	JP '791	11-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 16, 18-20, 23, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11-307791 (herein referred to as JP '791) in view of Yamagishi et al (U.S. Patent 6,300,556), Brandhorst, Jr (U.S. Patent 4,131,486), Spitzer (U.S. Patent 4,667,060), and Mitsui et al (U.S. Patent 4,649,088), with supporting evidence provided by the instant disclosure.

Regarding claim 16, JP '791 discloses a solar cell module (Figures 1 and 2) comprising a solar cell element (1); a light incidence side light transmitting member made of glass (3) adhered at a light incidence side of the solar cell element by a resin (EVA 2 lying between the cells 1 and glass 3; Paragraph 0023); a rear surface member comprising a resin film (PET film 4) adhered at a rear surface side of the solar cell element by a resin (EVA 2 lying between cells 1 and PET film 4; Paragraph 0023); wherein the solar cell element (Figure 2) comprises a semiconductor junction so as to form an electric field (Across pin junction formed by layers 11-13) and is sealed with the EVA resin layer 2 (Paragraphs 0023 and 0024).

Both the front surface side light transmitting member 3 and the rear surface member 4 transmit incident light (see Figures 1, 5, and 6). The sealing resin 2 is interposed between the front surface light transmitting member 3 and the solar cells 1 and is also interposed between the rear surface member 4 and the solar cells 1 (see Figure 1). With respect to the solar cell in JP '791's Figure 2, note in JP '791's paragraph 0024 that it is taught that on one principal plane of the n-type crystalline silicon substrate 11, there is laminated an i-type a-Si layer 12 and p-type a-Si layer 13. It is also taught that on the principal plane on another side of the n-type crystalline silicon substrate 11 there is laminated i-type a-Si layer 16 and n-type a-Si layer 17 (see paragraph 0024). The solar cell 1 has two transparent electrodes 14 and 18 at the top and bottom surfaces (see Figure 2; and paragraph 0024). These electrodes allow light to enter from both the front and rear surfaces of the solar cell module (see Figures 1, 5, and 6). The rear surface member is formed of a transparent resin film (PET) (see Figure 1; and paragraph (0025)).

JP '791 does not explicitly teach that the resin adhering the light incidence side light transmitting member at the light incidence side of the solar cell element contains sodium ion, nor does the reference explicitly disclose that a one conductive type crystalline semiconductor substrate is disposed between the semiconductor junction and the resin containing the sodium ion.

Yamagishi et al discloses the use of soda lime glass, which contains sodium, as a front surface member (Column 7, line 29). Soda lime glass is a conventional glass used in solar cell modules because it is inexpensive.

The instant disclosure teaches that sodium ions from the front glass in solar modules of this type diffuse from the glass into the resin that adheres the glass to the solar cells. After conventional testing, the amount of sodium disclosed as present in the resin is 0.3 $\mu\text{g/g}$. (Specification Page 5, line 19 - Page 7, line 2)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the solar cell module of JP '791 to use soda lime glass as the front surface member, as taught by Yamagishi et al, because soda lime glass is very inexpensive and provides excellent weather resistance. The selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07.

In such a combination, the presence of sodium ions in the resin lying between the cells and the glass member must be considered inherent, inasmuch as the instant disclosure teaches that sodium ions diffuse from a glass layer into the sealing resin under conventional conditions (Specification Page 5, line 19 - Page 7, line 2) Specific to claim 17, the specification teaches that this level of sodium ions in the resin results from standard test conditions, which would clearly obviously result in the combination taught above.

Regarding the position of the n-type crystalline substrate 11 with respect to the thin film amorphous layers 12, 13 and the light incidence side light transmitting member, the solar cell module of JP '791 allows light to enter from both sides (Figures 1, 5, and 6), but the front surface side light transmitting member 3 is at the principal light

incidence side (see paragraphs 0023 and 0026-0028). Therefore, light coming in from either direction contributes to the generation of electricity. Furthermore, with respect to the solar cell in JP '791's Figure 2, note in JP '791's paragraph 0024 that it is taught that on one principal plane of the crystalline silicon substrate 11, there is laminated an i-type a-Si layer 12 and p-type a-Si layer 13. It is also taught that on the principal plane on another side of the crystalline silicon substrate 11 there is laminated i-type a-Si layer 16 and n-type a-Si layer 17 (see paragraph 0024). JP '791 does not require said one principal plane on which the i-type a-Si layer 12 and p-type a-Si layer 13 to be the front face. JP '791 exemplifies the front face and recites "front face" in parenthesis for layers 12 and 13, and exemplifies the rear face and recites "rear face" in parenthesis for layers 16 and 17 (see paragraph 0024; and Figure 2). However, JP '791 does not require layers 12 and 13 to be at the front surface and layers 16 and 17 to be at the rear face. Thus, a skilled artisan readily recognizes that the solar cell seen in Figure 2 of JP '791 can be placed in JP '791's module in Figure 1 with layers 12 and 13 at the front face (i.e., layers 12 and 13 closer to light transmitting member 3) or at the rear face (i.e., layers 12 and 13 closer to rear surface member 4). Such is the case because the solar cell in said Figure 2 can receive light from both sides (see Figure 1; and the first sentence of paragraph 0024). Furthermore, the presence of a photovoltaic junction at the rear face of a solar cell is well known in the art as shown by Brandhorst, Jr (Figures 2 and 4; and col. 1, line 60 through col. 2, line 25) and Spitzer (see Figure 1).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared JP '701's solar cell module such that the solar

cell in JP '791's Figure 2 is present in the module with the p-i-n junction between layers 11, 12 and 13 at the rear face of the solar cell, and thus, the n-type crystalline silicon substrate 11 is between the resin adjacent principal light transmitting member 3 and the junction formed between p-type a-Si layer 13 and n-type substrate 11 because light can enter from both sides of JP '791's solar cell and thus, the p-i-n junction can be closer to either the light transmitting member 3 or the rear surface member 4; JP '791 is not limited to layers 12 and 13 to be at the front surface; and the presence of a photovoltaic junction at the rear face of a solar cell is well known in the art as shown by Brandhorst, Jr and Spitzer. In other words, to take the solar cell in JP '791's Figure 2, flip it over it over, and then insert it into JP '791's Figure 1, would have been within the level of ordinary skill in the art because light can enter from both sides of JP '791's solar cell in Figure 2, and thus, the p-i-n junction can be closer to either the light transmitting member 3 or the rear surface member 4; JP '791 is not limited to layers 12 and 13 to be at the front surface; and the presence of a photovoltaic junction at the rear face of a solar cell is well known in the art as shown by Brandhorst, Jr and Spitzer.

Regarding the anti-reflection layer limitations, JP '791 does not explicitly disclose an anti-reflection layer comprising silicon oxide positioned between the one conductive type semiconductor and the sodium ion-containing resin.

Mitsui et al teaches an antireflection coating for light-receiving surfaces of photoelectric devices (Abstract, summary sections), comprising a silicon dioxide layer. (Figure 4, layers 8a and 8b; Column 4, lines 14-54; Silicon oxide of 1.45 refractive index is silicon dioxide)

It would also have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of JP '791 by providing the anti-reflective coating of Mitsui on the light receiving surfaces of the solar cell, as taught by Mitsui, because Mitsui teaches that providing this layer on a silicon solar cell surface reduces reflection significantly relative to a solar cell without the coating. (Column 4, lines 46-50; Column 3, lines 47-53 for comparison) A skilled artisan would have recognized the advantage of this coating in increasing the amount of radiation absorbed by the cells, and thus increasing the overall efficiency of the system.

Regarding claim 18, JP '791 teaches that n-type substrate 11 consists of single crystalline silicon. (Paragraph 0024) As there is no teaching of a thickness required to shield diffusion of sodium ion in the instant specification, the thickness of this substrate is considered to inherently provide some shielding of the diffusion of sodium ion as claimed.

Regarding claim 19, in the combination described above, n-type a-Si layer 17 will be disposed between the n-type c-Si substrate 11 and the resin containing sodium ion.

Regarding claim 20, in the combination described above, transparent ITO electrode 18 will be disposed between the n-type a-Si layer 17 and the resin containing sodium ion.

Regarding claim 23, in the combination described above, the semiconductor junction is formed between the n-type crystalline substrate 11 and the p-type amorphous layer 13.

Regarding claim 24, in the combination described above, i-type a-Si layer 12 is disposed between p-type a-Si layer 13 and n-type c-Si substrate 11.

In this rejection undue weight cannot be given to the limitation “to shield a diffusion of sodium ion to the semiconductor junction”, because this is a recitation of intended function or use. A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). In this case, no structure that is distinct from that taught by the prior art is required by the limitation.

Claims 16, 18-20, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brandhorst, Jr. in view of Mimura et al, and Mitsui et al, with supporting evidence provided by the instant disclosure.

Regarding claim 16, Brandhorst, Jr. discloses a solar cell element comprising a semiconductor junction so as to form an electric field (i.e. junction 11 between p-type substrate 10 and n+ type layer 12; Figure 1) The cell is designed such that incident light is to impinge upon the cell on the side of substrate 10 opposite junction 11.

Regarding claim 18, Brandhorst, Jr. discloses that p-type substrate 10 comprises single crystal silicon. (Column 2, lines 7-9)

Regarding claim 19, Brandhorst, Jr. teaches a p+ layer 16 disposed on the light-incident side substrate 10.

Regarding claim 20, electrode layer 18 of Brandhorst, Jr. allows light to pass into the cell (Column 3, lines 8-14), and therefore reads on a “transparent electrode”.

Regarding claim 22, Brandhorst, Jr. discloses that n+ layer 12 is formed by diffusion of n-type dopants into crystalline substrate 10. (Column 2, lines 60-66) The layer is therefore crystalline as claimed.

Regarding claim 25, Brandhorst, Jr. discloses that p+ layer 16 is formed by diffusion of p-type dopants into crystalline substrate 10. (Column 3, lines 3-8) The layer is therefore crystalline as claimed.

Brandhorst, Jr. does not explicitly disclose the instant light incidence side light transmitting member, rear surface member, resin, or sodium ion present in the resin. Brandhorst, Jr. is silent concerning encapsulation of the cell.

Mimura et al teach an encapsulation system for solar cells (Figure 1), comprising a soda-lime glass light incident side light transmitting member (105; Column 7, lines 25-67) that is adhered to a light incidence side of the solar cell by a resin (Filler 103 disposed between the cells and glass; Figure 1; Column 6, lines 52-67); a rear surface member comprising a resin film (e.g. TEDLAR Backside covering member 102; Column 6, lines 29-51) that is adhered to the rear surface of the solar cell by a resin (Filler 103 disposed between the cells and member 102; Figure 1; Column 6, lines 52-67) The cells are sealed in filler 103 between plate 105 and member 102. (Figure 1)

The instant disclosure teaches that sodium ions from the front glass in solar modules of this type diffuse from the glass into the resin that adheres the glass to the solar cells. After conventional testing, the amount of sodium disclosed as present in the resin is 0.3 $\mu\text{g/g}$. (Specification Page 5, line 19 - Page 7, line 2)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of Brandhorst, Jr. by specifically encapsulating the cells in the encapsulation system of Mimura et al, because Mimura suggests that any conventional cell is suitable for encapsulation in their system (Column 7, lines 1-6), and it is well recognized in the art that the useful lifetime of silicon solar cells is greatly lengthened by encapsulating them to protect them from corrosion caused by atmospheric oxygen and water vapor. In such a combination, obviously the light incident side of Brandhorst, Jr. (Top side in Figure 1) would be placed closest to the glass layer 105 of Mimura et al, since layer 105 faces incoming radiation. (Mimura et al Figure 1; Column 7, lines 25-32) Such positioning meets the limitations of claims 16, 18-20, 22, and 25.

In such a combination, the presence of sodium ions in the resin filler lying between the cells and the glass member must be considered inherent, inasmuch as the instant disclosure teaches that sodium ions diffuse from a glass layer into the sealing resin under conventional conditions (Specification Page 5, line 19 - Page 7, line 2) Specific to claim 17, the specification teaches that this level of sodium ions in the resin results from standard test conditions, which would clearly obviously result in the combination taught above.

Regarding the anti-reflection layer limitations, JP '791 does not explicitly disclose an anti-reflection layer comprising silicon oxide positioned between the one conductive type semiconductor and the sodium ion-containing resin.

Mitsui et al teaches an antireflection coating for light-receiving surfaces of photoelectric devices (Abstract, summary sections), comprising a silicon dioxide layer. (Figure 4, layers 8a and 8b; Column 4, lines 14-54; Silicon oxide of 1.45 refractive index is silicon dioxide)

It would also have been obvious to one having ordinary skill in the art at the time the invention was made to modify the cell of Brandhorst, Jr. by providing the anti-reflective coating of Mitsui on the light receiving surface of the solar cell, as taught by Mitsui, because Mitsui teaches that providing this layer on a silicon solar cell surface reduces reflection significantly relative to a solar cell without the coating. (Column 4, lines 46-50; Column 3, lines 47-53 for comparison) A skilled artisan would have recognized the advantage of this coating in increasing the amount of radiation absorbed by the cells, and thus increasing the overall efficiency of the system.

Regarding claim 18, since there is no teaching of a thickness required to shield diffusion of sodium ion in the instant specification, the thickness of substrate 10 of Brandhorst, Jr. is considered to inherently provide some shielding of the diffusion of sodium ion as claimed.

Claims 16, 18-20, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mimura et al in view of Brandhorst, Jr., and Mitsui et al, with supporting evidence provided by the instant disclosure.

Regarding claim 16, Mimura et al teach an encapsulation system for solar cells (Figure 1), comprising a soda-lime glass light incident side light transmitting member (105; Column 7, lines 25-67) that is adhered to a light incidence side of the solar cell by a resin (Filler 103 disposed between the cells and glass; Figure 1; Column 6, lines 52-67); a rear surface member comprising a resin film (e.g. TEDLAR Backside covering member 102; Column 6, lines 29-51) that is adhered to the rear surface of the solar cell by a resin (Filler 103 disposed between the cells and member 102; Figure 1; Column 6, lines 52-67) The cells are sealed in filler 103 between plate 105 and member 102. (Figure 1)

Mimura et al do not specifically teach a solar cell element comprising a one conductive type crystalline semiconductor substrate between the semiconductor junction and resin containing sodium ion.

Regarding claim 16, Brandhorst, Jr. discloses a solar cell element comprising a semiconductor junction so as to form an electric field (i.e. junction 11 between p-type substrate 10 and n+ type layer 12; Figure 1) The cell is designed such that incident light is to impinge upon the cell on the side of substrate 10 opposite junction 11.

Regarding claim 18, Brandhorst, Jr. discloses that p-type substrate 10 comprises single crystal silicon. (Column 2, lines 7-9)

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Regarding claim 22, Brandhorst, Jr. discloses that n+ layer 12 is formed by diffusion of n-type dopants into crystalline substrate 10. (Column 2, lines 60-66) The layer is therefore crystalline as claimed.

The instant disclosure teaches that sodium ions from the front glass in solar modules of this type diffuse from the glass into the resin that adheres the glass to the solar cells. After conventional testing, the amount of sodium disclosed as present in the resin is 0.3 µg/g. (Specification Page 5, line 19 - Page 7, line 2)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of Mimura et al by specifically installing the solar cells of Brandhorst, Jr., because Mimura suggests that any conventional cell is suitable for encapsulation in their system (Column 7, lines 1-6), and Brandhorst, Jr. teaches that his cells provide superior latitude in junction formation and low contact resistance, which would have been recognized as advantageous to one having ordinary skill in the art. In such a combination, obviously the light incident side of Brandhorst, Jr. (Top side in Figure 1) would be placed closest to the glass layer 105 of Mimura et al, since layer 105 faces incoming radiation. (Mimura et al Figure 1; Column 7, lines 25-32) Such positioning meets the limitations of claims 16, 18-20, 22, and 25.

In such a combination, the presence of sodium ions in the resin filler lying between the cells and the glass member must be considered inherent, inasmuch as the instant disclosure teaches that sodium ions diffuse from a glass layer into the sealing resin under conventional conditions (Specification Page 5, line 19 - Page 7, line 2) Specific to claim 17, the specification teaches that this level of sodium ions in the resin results from standard test conditions, which would clearly obviously result in the combination taught above.

Regarding the anti-reflection layer limitations, JP '791 does not explicitly disclose an anti-reflection layer comprising silicon oxide positioned between the one conductive type semiconductor and the sodium ion-containing resin.

Mitsui et al teaches an antireflection coating for light-receiving surfaces of photoelectric devices (Abstract, summary sections), comprising a silicon dioxide layer. (Figure 4, layers 8a and 8b; Column 4, lines 14-54; Silicon oxide of 1.45 refractive index is silicon dioxide)

It would also have been obvious to one having ordinary skill in the art at the time the invention was made to modify the cell of Brandhorst, Jr. by providing the anti-reflective coating of Mitsui on the light receiving surface of the solar cell, as taught by Mitsui, because Mitsui teaches that providing this layer on a silicon solar cell surface reduces reflection significantly relative to a solar cell without the coating. (Column 4, lines 46-50; Column 3, lines 47-53 for comparison) A skilled artisan would have recognized the advantage of this coating in increasing the amount of radiation absorbed by the cells, and thus increasing the overall efficiency of the system.

Regarding claim 18, since there is no teaching of a thickness required to shield diffusion of sodium ion in the instant specification, the thickness of substrate 10 of Brandhorst, Jr. is considered to inherently provide some shielding of the diffusion of sodium ion as claimed.

(10) Response to Argument

Appellant argues that the final rejection "selectively picks and chooses various isolated and individual elements from various disparate prior art references in a hindsight attempt to recreate the claimed invention". In response to such argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the Appellant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). Note that Appellant provides no specific arguments against the motivations that are provided for the modifications to the primary reference.

Appellant further asserts an "utter lack of any evidence for the final rejection's complete dismantling of the structure of the JP '791 reference and rebuilding of such structure in attempt to recreate the invention set forth in claim 16." Again, Appellant fails to provide any specific argument against the reasoning provided. Note also that only one of the three pending rejections actually relies upon the JP '791 reference.

The rejection based on JP '791 is based upon two modifications to this reference. First, the glass taught as the incident light transmitting member in JP '791 is not specifically taught as a sodium-containing glass. Yamagishi et al is relied upon to teach the conventionality of using soda-lime glass, which contains sodium ions, in such an application. In addition, the JP '791 reference does not specifically show a semiconductor substrate as claimed lying between the semiconductor junction and resin containing sodium ion. However, JP '791 shows the solar cell receiving light from on both front and rear surfaces (Figure 1), and Brandhorst Jr. and Spitzer demonstrate that positioning of the active junction on the side of the substrate that is away from the incoming radiation is conventional in the art. Since such a configuration was conventional in the art, and it is clear that the cells of JP '791 can receive radiation on either face of the cell, only the predictable result of a functioning solar module would result from this modification. Appellant's bare assertions of hindsight reasoning, "complete dismantling", and "utter lack of evidence" do not address the reasoning provided.

Appellant provides descriptions of each of the individual references, pointing out how each lacks structure required in the claims. The Examiner agrees that no single one of the references includes all claim limitations. These descriptions however fail to address the motivations provided in the rejections, upon which the rejections are based.

Regarding the reliance on Appellant's disclosure, Appellant asserts that the portion relied upon (Page 5, line 19 - Page 7, line 2) is not an admission of prior art, and is therefore improperly relied upon. The Examiner respectfully disagrees. The cited

portion of Appellant's specification teaches that an industry standard test (JIS C8917) on a solar module results in sodium ion deposition into the sealing resin from the front glass. The combination of Yamagishi et al with JP '791 provides sodium ion-containing soda lime glass adjacent sealing resin, precisely as in Appellant's claimed module. It appears to the Examiner to be quite reasonable to take the position that if sodium ions diffuse into Appellant's resin from the front glass under industry standard test conditions, they would also do so in the identical structure provided in the obvious combination of the prior art. There is no reason to believe that these structures having the same features would behave any differently. Furthermore, it is a physical reality that at temperatures to which solar modules are conventionally exposed over time, ions present in the front glass, such as sodium ions, will diffuse into adjacent layers, such as the resin layer taught in the prior art. Appellant has provided no evidence or arguments to the contrary, so there is no reason to change this position.

Appellant argues that it has been demonstrated how the claimed structure is not found or suggested by any of the prior art references relied upon and further argues that the rejection has failed to establish "by any evidence, much less substantial evidence" how the prior art "as a whole" suggests the claimed invention "as a whole". The Examiner replies that Appellant has failed to provide persuasive arguments addressing the reasoning clearly provided in the rejections. Appellant has instead resorted to general allegations of hindsight reasoning and unsupported assertions of improper picking and choosing. The Examiner therefore maintains that the rejections are proper.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Jeffrey T. Barton/

Art Unit 1795

Conferees:

/Nam X Nguyen/

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